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Comparison Of Femur Length With Gestational Age Including Or Excluding The Spur Of Femur

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ABSTRACT

Background: *Femur is a long bone that measures gestational age and contributes to human height and weight, but can also be affected by growth retardation or skeletal growth abnormalities.* ***Objective:*** *To compare the effect of femur length on gestational age of fetus using ultrasonography.* ***Methods:*** *The research was a four-month crossectional study carried out in a private hospital in Tehsil Kharian, District Gujrat, Pakistan. Data was obtained using a simple sampling strategy from December 2022 to March 2023. As a matter of convenience, a sample size of 100 patients was chosen. In compliance with ethical norms described by the research committee, the data was obtained after the patient granted informed consent. Data was entered and analyzed using SPSS version 20.0.* ***Results:*** *This study revealed that 42% females were in early 2nd trimester of gestation, 31% females were in late 2nd trimester of gestation, 21% females were in early 3rd trimester of gestation and only 6% females were at term.* ***Conclusion:*** *In conclusion, based on femur length, ultrasonography is sensitive and accurate in predicting fetal gestational age.*

Keywords: gestational age, femur length, ultrasonography, sensitivity and specificity

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INTRODUCTION

The femur is one of the long bone of the body.[1] In humans femur length contributes to the height and weight of a person, but in fetal life it helps in the calculation of gestational age and fetal weight. [2] It is frequently assessed in the second and third trimesters of pregnancy to determine the fetus' gestational age and compute the EDD. [3, 4] Ultrasound is commonly used to determine femur length which is first-line modality, safe and easy to approach(less costly). [5] Estimating gestational age using femur length measurement using ultrasonography also reveal growth retardation, aneuploidy and severe short femoral length indicate skeletal dysplasias. [6, 7] For measurement of the femur length the ultrasound probe/transducer should be positioned at right angle to the long axis of the femur and must include the femoral head and femoral condyle. [8] The measuring cursor will cover the length from the femoral head all way to the femoral condyle. 9, 10 The average femoral length of a fetus in 2nd trimester ranges between 16-53 mm and in 3rd trimester the length of femur is in between 55-79 mm. [11, 12]

Ming-Neng Yeh, M.D., did a study at Columbia University and determined that femur length is a more exact measure than BPD for estimating gestational age. This study proposed that ultrasound assessment of femur length is most precise and effective method for estimation of fetal growth and development. [13] Another study concluded that femur length measurement is a reproducible parameter for estimation of fetal age and is appeared to be as accurate as bi-parietal diameter; it is an additional parameter for accurate estimation of fetal age. [14] In the third trimester, femur length is

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an excellent predictor of gestational age, albeit it is not necessarily superior than bi-parietal diameter.[15] Nonetheless, if abnormal fetal development is detected, femur length is most likely the optimal gestational age estimate. [16] The measurement of femur length in correspondence with other gestational parameters is considered a standard parameter for the evaluation of gestational age or fetal age. [17]

The measurement of fetal femur length is an essential component of prenatal ultrasound screening, as it can aid in the accurate determination of gestational age, fetal growth evaluation, and the identification of fetal abnormalities. [18, 19] However, there is a lack of unanimity about the relationship between femur length and gestational age, with differences reported in different cultures and races. [20, 21] Thus, the problem statement for this study is to determine the comparability of femur length with gestational age in a diverse population and examine the factors that may influence this correlation, such as maternal age, BMI, fetal sex, and ethnicity. The findings of this study can inform clinical practice and ensure accurate prenatal diagnosis and management.

The goal of research is to compare femur length with gestational age in fetuses and establish normative data for femur length during different stages of the pregnancy. This study is significant because fetal femur length is a crucial metric used to determine gestational age and track fetal development during pregnancy. Accurate femur length measurement is critical for detecting prenatal growth problems and providing appropriate diagnosis and therapy. This study can also help clinicians to identify any deviations from normal femur length growth patterns and enable early identification and treatment of fetal growth defects.The rationale for the study is that femur length measurement is a non-invasive and reliable method for assessing fetal growth during pregnancy. The femur is one of the longest bones in the body, and its growth rate correlates well with fetal gestational age. This study shows that it is an efficient tool for determining fetal growth patterns and providing critical information about fetal development throughout pregnancy. The comparison of femur length with gestational age can provide clinician with valuable information to monitor fetal growth and development, enabling earlier identification of growth abnormalities and improving pregnancy outcomes.

MATERIAL AND METHDOLOGY

The study was carried out in a private hospital in Tehsil Kharian, District Gujrat, Pakistan. The data was reviewed retrospectively from December 20, 2022 to March 20, 2023, as part of a four-month cross-sectional research with a convenient sampling strategy. A sample size of 100 patients was considered following from a previously published study. [22] In compliance with ethical norms described by the research committee, the data was obtained after the patient granted informed consent. The research covered patients aged 18-40 years with a gestational age of 14-42 weeks, omitting patients of first trimester. The mother was laying supine on the couch when the examination was performed using a trans-abdominal approach. Preferably, the ultrasonic transducer/probe should be placed at right angle to the long axis of the femur. The femoral head, also known as the greater trochanter and the femoral condyle both should be visible at the same time. The bone should be measured with the cursor placed at the junction of bone and cartilage. In this examination, Mindray and Toshiba ultrasound equipment were employed with a curvilinear scan probe with a scan frequency of 5-7 MHz.

RESULTS

The current investigation was carried out in a private hospital with a sample of 100 individuals who came to the ultrasound department for obstetrical ultrasonography. The total number of patients was 100 of which there were 42% females with early 2nd trimester of gestation, 31% females were of late 2nd trimester of gestation, 21% females were early 3rd trimester of gestation and only 6% females were at term, as illustrated in table 2.

TABLE 1: Illustrate frequency distribution of maternal age

MATERNAL AGE			
		Frequency	Percent
Valid	18-22	16	16.0
	23-27	38	38.0
	28-32	30	30.0
	33-40	16	16.0
	Total	100	100.0

The total number of patients was 100 in the current study in which females of age ranging from 18-40 years were included. There are 16% patients between 18-22 years of age, 38% patients between 23-27 years of age, 30% patients between 28-32 years and 16% patients between 33-40 years, as shown in table 1.

TABLE 2: Illustrate frequency distribution of gestational age according to trimesters

GESTATIONAL AGE ACCORDING TO TRIMESTER			
		Frequency	Percent
Valid	Early 2nd Trimester	42	42.0
	Late 2nd Trimester	31	31.0
	Early 3rd Trimester	21	21.0
	At Term	6	6.0
	Total	100	100.0

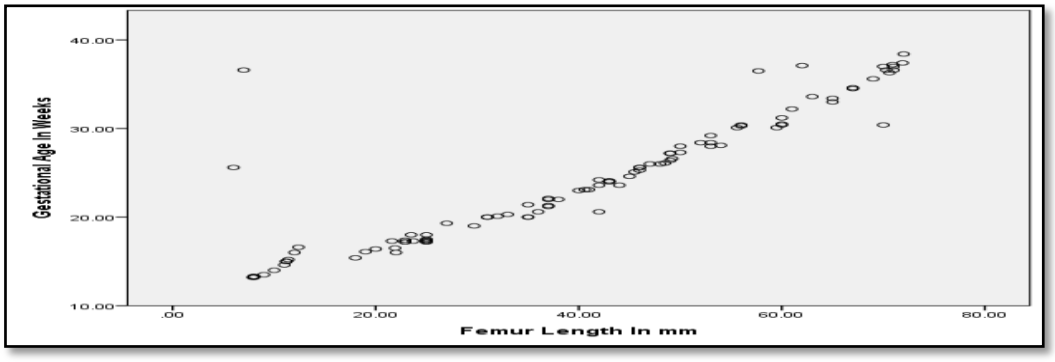

Figure 1: scatter plot shows the linearity and correlation between the femur length and gestational age.

Table 3: Shows the correlation between gestation age and femur length.

		Gestational Age In Weeks	Femur Length In mm
Gestational Age In Weeks	Pearson Correlation	1	.900**
	Sig. (2-tailed)		.000
	N	100	100
Femur Length In mm	Pearson Correlation	.900**	1
	Sig. (2-tailed)	.000	
	N	100	100
**. Correlation is significant at the 0.01 level (2-tailed).			

TABLE 4: shows the regression between gestation age and femur

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.900[a]	.809	.807	3.18103
a. Predictors: (Constant), Femur Length In mm				
b. Dependent Variable: Gestational Age In Weeks				

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	10.720	.736		14.557	.000
	Femur Length In mm	.338	.017	.900	20.394	.000
a. Dependent Variable: Gestational Age In Weeks						

The linear regression result indicates that a regression model was fitted to the data. The R value in the model summary is 0.900, indicating a substantial positive association between the dependent and independent variables. This value is also more than 0.5, indicating that the model is well-suited to the data. The R square value of 0.809 indicated that the independent variable could account for about 80.9% of the variance in the dependent factor. The coefficient table displays the predicted beta coefficient values for predictor variables. The beta value for constant (gestational age "a") is

10.720, and the beta value for femur length is 0.338, giving a suitable regression equation Y= 10.720+0.338x. This means that the predicted change in the dependent variable is 0.338 for every unit change in femur length. The significant result of 0.000 indicates that the beta coefficient for femur length differs from zero, implying that it is an important predictor of the dependent variable. Overall, this linear regression model fits the data well and indicates a robust link between femur length and gestational age.

DISCUSSION

Femur length is a measurement used to calculate gestational age because it is readily identified due to its echogenicity. [23]The length of femur is usually measured including or excluding the femoral spur. The variance in age and weight of the fetus may occur due to improper measuring of the femur. Variation in femur length might occur as a result of growth variability. In some cases the femur appears short or long due to growth restrictions or skeletal dysplasias. In current study 100 patients were included with 42% females were of early 2nd trimester of gestation, 31% females were of late 2nd trimester of gestation, 21% females were of early 3rd trimester of gestation and only 6% females were at term. It shows that there is a high ratio of females with early 2nd trimester of gestation. A research published in 2007 by Aaron B. Caughey found that early obstetric ultrasonography provides better pregnancy dates and lowers the likelihood of problems. [24] There is a substantial positive association between gestational age and femur length. This indicates that as gestational age grows, so does femur length and thus produces accurate diagnosis for gestational age. The difference between gestational age and femur length is significant, which shows that femur length is substantially significant in prediction of gestational age as compare to other parameters. A previous study by Dr. K. EphraimVikram Rao published in 2022 had similar results that femur length is a strong indicator of prenatal gestational age. [25] Another study by E. Shalev also concluded that the length of the femur is a valid measure for determining gestational age. [26] According to the current study, 0.338 rises in gestational age is predicted for every unit increase in femur length. According to a research by M Honarvar and M Allahyari, femur length is clinically reliable and easy to predict changes in fetal gestational age. [27] Another study, done by Osinusi BO, established a linear regression model adequate for predicting the link between gestational age and femur length. [28]

CONCLUSION

In conclusion, ultrasonography is a reliable and sensitive measure for determining fetal gestational age based on femur length. The current investigation, which was done on patients in Kharian, Pakistan, discovered a substantial positive association between femur length and gestational age. In addition to estimating gestational age, femur length measurement may be used to identify fetal bone abnormalities.

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